Integrated Disposal Facility Performance Assessment (PA)

Technical Approach

Presenters

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October 19, 2017

Outline

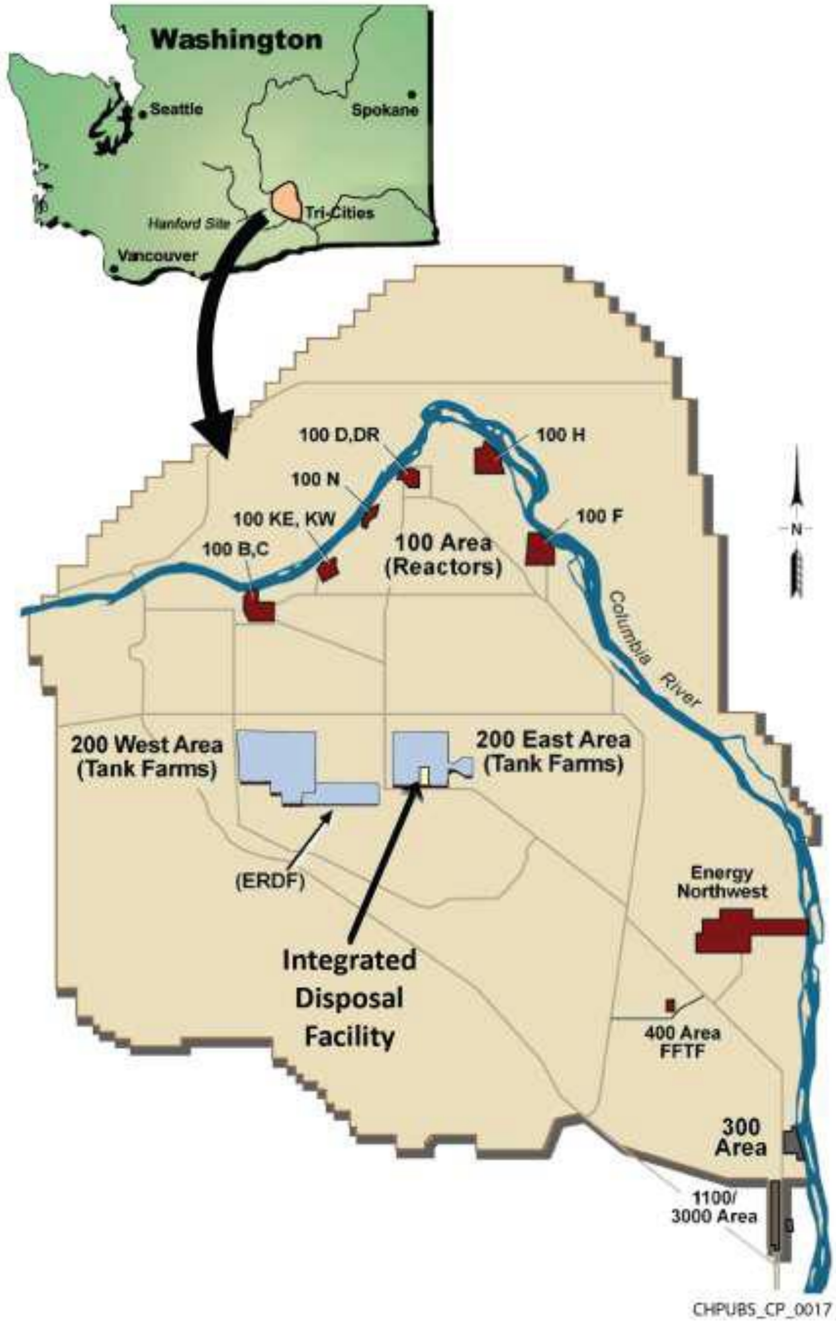
- Purpose of Integrated Disposal Facility (IDF)
- Location of IDF in Hanford Site
- Goals and objectives of IDF Performance Assessment (PA)
- IDF PA performance objectives and measures
- Key Characteristics of IDF
- History of activities related to IDF
- Phased approach for developing IDF PA
- Comparison to *Tank Closure & Waste Management EIS*
- Technical approach for IDF PA
- Current Status

Integrated Disposal Facility (IDF)

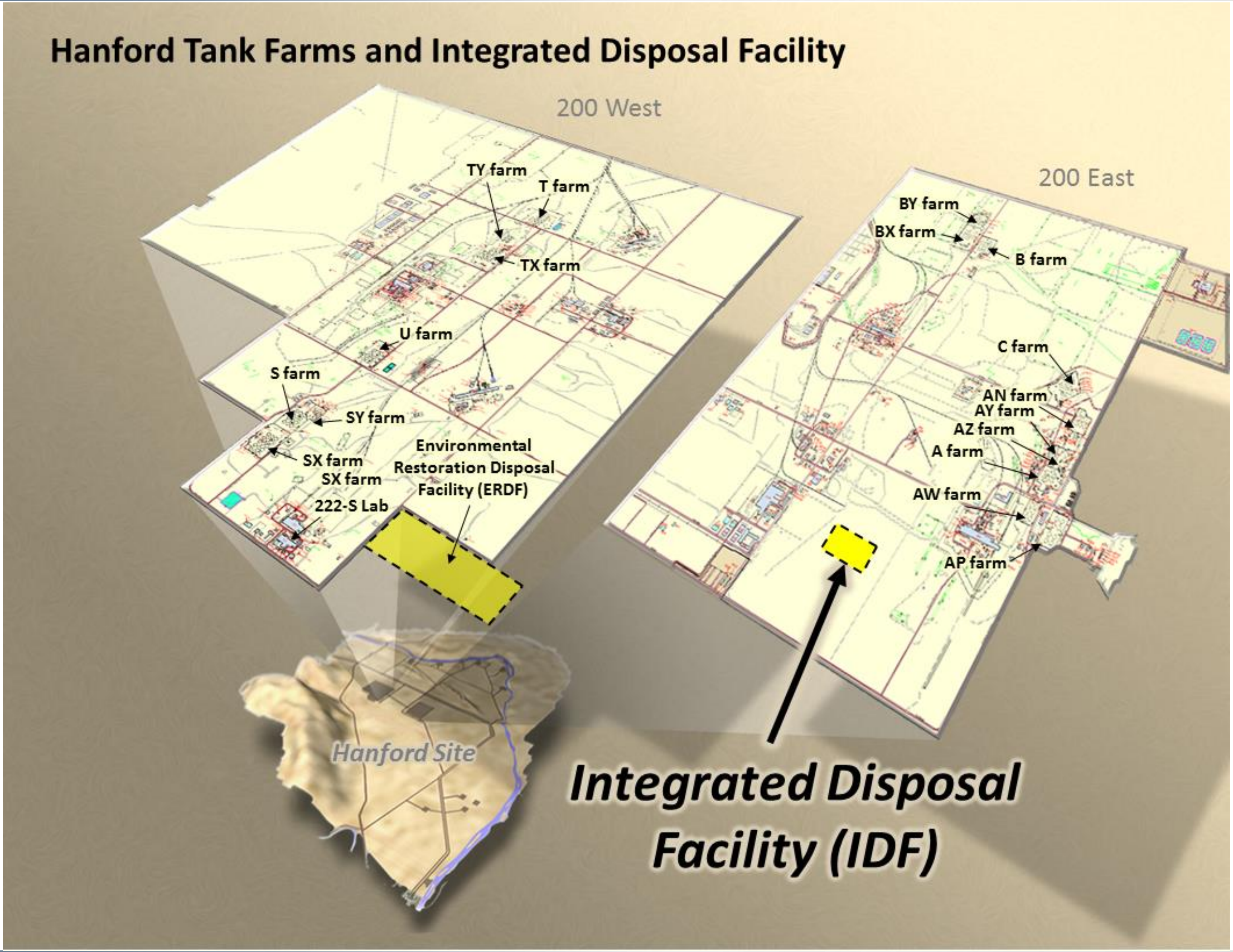
- The IDF is a surface disposal facility designed to dispose of low-level radioactive waste (LLW) and mixed-low-level radioactive waste (MLLW) resulting from operation of the Waste Treatment and Immobilization Plant (WTP), as well as other MLLW
- The radioactive waste portions of the LLW and MLLW are regulated by the U.S. Department of Energy through DOE O 435.1
- The hazardous chemical portion of the MLLW is regulated by the State of Washington Department of Ecology. The IDF is a RCRA-permitted facility.
- The IDF PA models the expected post-closure performance of the facility and compares the results to performance objectives and performance measures

Hanford Site

- 586 square miles in southeastern Washington State
- Located about 170 miles southeast of Seattle
- Columbia River flows through the site and forms the eastern boundary
- Used for plutonium production from 1943 to 1987
- 56 million gallons of radioactive wastes is in tank farms located in the 200 East and 200 West Areas
- Tank farm waste to be treated at Waste Treatment and Immobilization Plant (WTP)



Tank Farms and IDF Location on Hanford Site



Aerial View of 200 East Area (View to West)

Environmental Restoration Disposal Facility (ERDF)

US Ecology

BC Cribs and Trenches

Integrated Disposal Facility

Plutonium Uranium Extraction (PUREX)

Current Configuration of IDF (View to South)

Storage tanks for leachate collection and recovery system

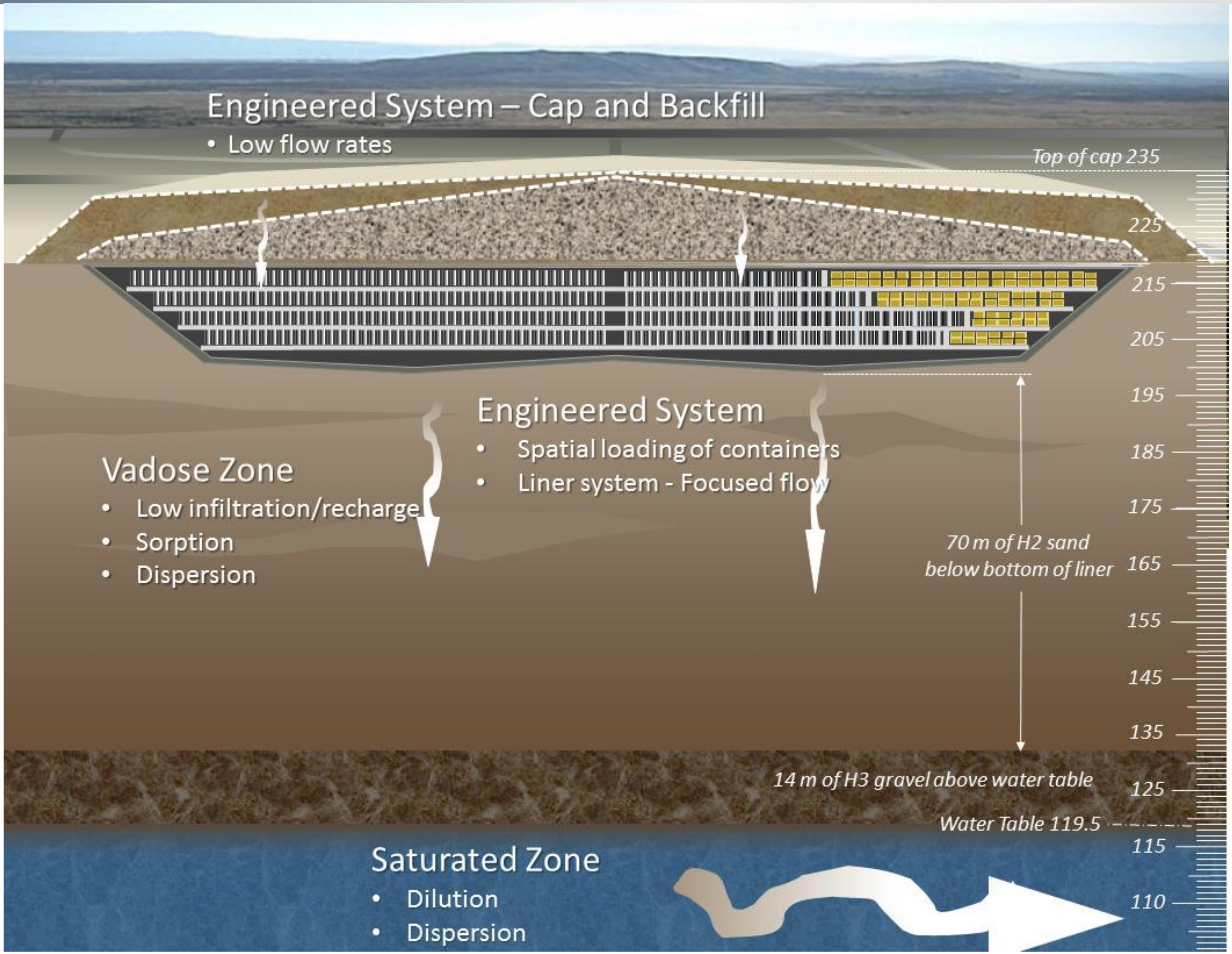
- West-east (berm to berm) = 422 m (1384 ft)
- West-east (operations layer) = 331 m (1085 ft)
- North-south (current operations layer) = 110 m (360 ft) (expandable to south)

IDF Performance Objectives and Measures – Derived from DOE O 435.1 and DOE M 435.1-1

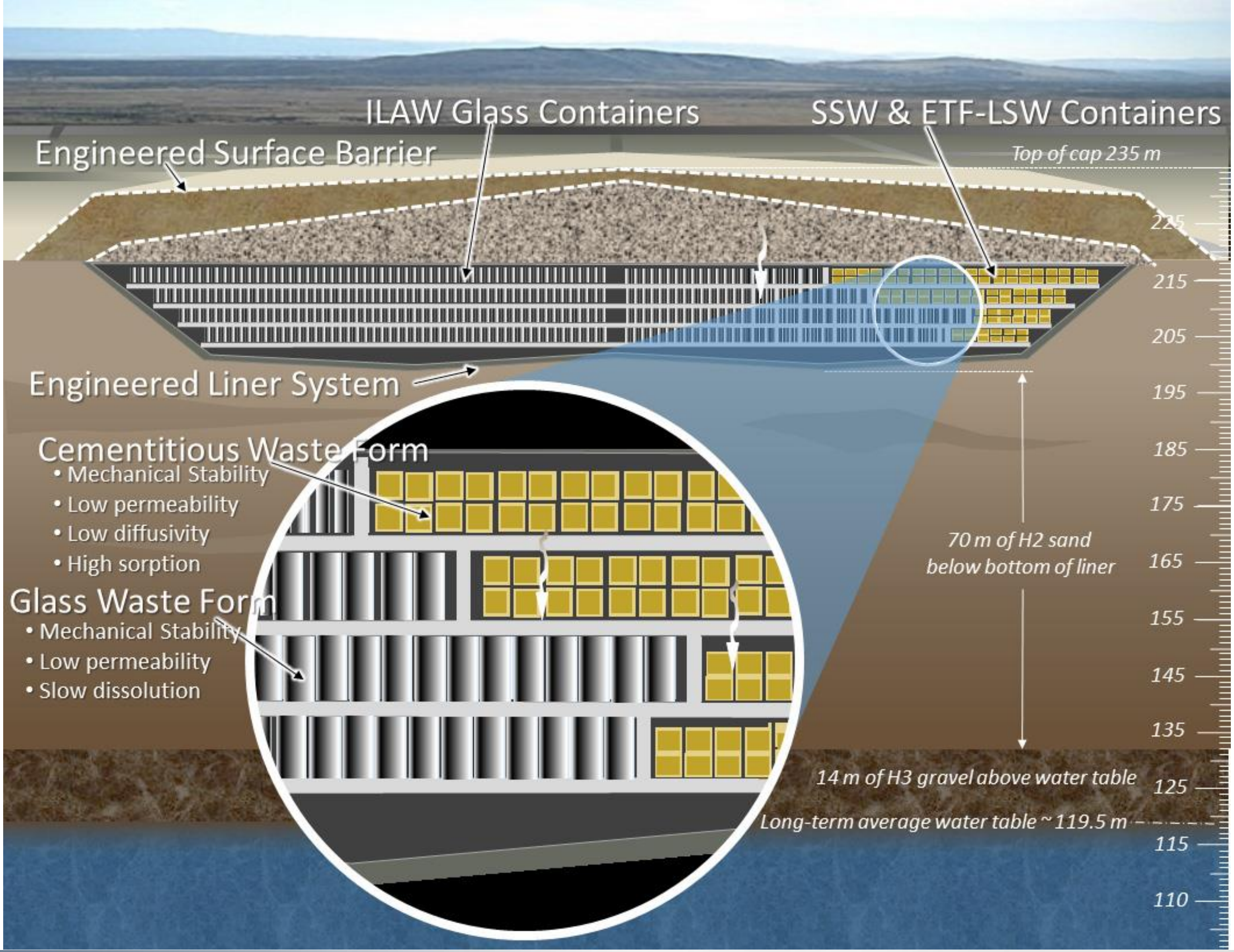
- All-pathway total effective dose < 25 mrem/yr to a representative member of the public, excluding the dose from radon[1]
- Air-pathway total effective dose < 10 mrem/yr to a representative member of the public, excluding the dose from radon[1]
- Radon dose release rate from the facility < 20 pCi/m^2/sec or concentration < 0.5 pCi/L at the receptor location
- Water resources impacts < applicable state or federal drinking water standards
- Acute exposure dose < 500 mrem/yr and chronic exposure dose < 100 mrem/yr as the result of an inadvertent intrusion into the waste

[1] Point of assessment located at point of maximum dose beyond a 100-m buffer zone surrounding the waste

Key IDF Characteristics – Natural System



Key IDF Characteristics – Engineered System



General Timeline of IDF Activities

- 1998 DOE issues the Immobilized Low-Activity Waste (ILAW) Performance Assessment (PA) and initiates LFRG review
- 2003 DOE applies to Washington State Department of Ecology (Ecology) for a Dangerous Waste Permit for Integrated Disposal Facility
- 2006 DOE completes Phase 1 construction of IDF (Cells 1 & 2)
- 2009 DOE issues the draft Tank Closure and Waste Management Environmental Impact Statement (*TC&WM EIS*)
- 2012 DOE issues the final *TC&WM EIS*
- 2012 DOE issues guidance on Modeling to Support Regulatory Decisionmaking at Hanford
- 2013 DOE issues the Record of Decision to implement Waste Management Alternative 2 (without Tc-99 removal) from the *TC&WM EIS*

Tank Closure & Waste Management EIS

- Draft *TC&WM EIS* in 2008; Final *TC&WM EIS* in 2012
- Includes extensive analyses of IDF-East performance
- Used as a basis for the Record of Decision to proceed with IDF-East to dispose
  - ILAW glass, WTP-generated secondary solid waste, ETF-generated secondary waste, FFTF wastes, on-site non-CERCLA non tank wastes and other secondary waste
- Used a common set of agreed to assumptions, model input parameters and methodologies with a focus on:
  - Barrier performance specifications
  - Waste form release coefficients
  - Vadose zone and groundwater Kd
  - Inventory quantities and assumptions
- Starting point for other regulatory decision-making products (i.e., PAs)

WTP = Waste Treatment and Immobilization Plant; ETF = Effluent Treatment Facility;
FFTF = Fast Flux Test Facility;
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980;*

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Hanford *Tank Closure and Waste Management* – Record of Decision (Dec. 6, 2013)

- "DOE has decided to implement Waste Management Alternative 2, which includes disposal of LLW and MLLW in IDF-East from tank treatment operations, waste generated from WTP and ETF operations, on-site non-CERCLA sources, FFTF decommissioning waste and on-site waste management waste. . . DOE will defer a decision on importing waste from other DOE sites (with limited exceptions as described in the settlement agreement with Ecology) for disposal at Hanford at least until the WTP is operational."

DOE = U.S. Department of Energy; LLW = Low Level Radioactive Waste;
MLLW = Mixed Low Level Radioactive Waste; IDF = Integrated Disposal Facility;
WTP = Waste Treatment and Immobilization Plant; ETF = Effluent Treatment Facility;
FFTF = Fast Flux Test Facility;
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980;*
Ecology = Washington State Department of Ecology

DOE Guidance - Modeling to Support Regulatory Decisionmaking at Hanford (Oct. 9, 2012)

- Facility-specific modeling, e.g., performance and risk assessments, should build upon modeling tools and assumptions used in the *TC&WM EIS*
- Must use best available estimates of natural system parameters
- Basic elements include:
  - Phased approach (planning, scoping, and analysis phases)
  - Identify any changes to modeling tools, parameters and assumptions used in *TC&WM EIS*
    - Ensure changes are agreed to DOE/ORP and DOE/RL Groundwater Vadose Zone Executive Council
  - Develop a model case that uses the same assumptions and methods used in the *TC&WM EIS* "base case"
  - Comply with software QA requirements in DOE O 414.1D

Phased Approach for Hanford Modeling to Support Regulatory Decisions

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Summary Analysis

- Defines the overall approach for carrying out the performance assessment and for complying with the Alice Williams' memorandum
- Identifies the modeling tool set to be used and justifies any differences from the TC&WM EIS tool set
- Identifies the proposed action to be evaluated (e.g., engineered disposal system, waste forms, inventories) and justifies any differences from the TC&WM EIS ROD
- Identifies the representation(s) of the natural system (e.g., soil properties, groundwater flow field) and justifies any differences from the TC&WM EIS assumptions and modeling parameters
- For decisions made in by the TC&WM EIS ROD, describes approach for establishing traceability to the EIS base case

Planning Phase

- Develop project management plan, cost, & schedule
- Develop proposed scoping approach
- Prepare for scoping process and identify participants
- Review prior and existing data packages to determine new or updated information that may be needed
- Inform GW/VZ Executive Council and other decision makers, as appropriate

Scoping Phase

- Conduct scoping meetings with stakeholders and regulators to present proposed scope & refine
- Prepare Draft Summary Analysis for review by the GW/VZ Executive Council
- Define approaches for conducting sensitivity and uncertainty analyses
- Finalize modeling approach (e.g., modeling tool sets) and cases, including base case parameter assumptions
- Prepare and submit Final Summary Analysis to obtain concurrence to proceed with analysis phase

GW/VZ Executive Council Approval of Approach

Analysis Phase

- Conduct model analyses, including sensitivity analysis and uncertainty analysis
- If significant changes are made to the approach, prepare revisions to the Summary Analysis and obtain approvals
- Conduct work-in-progress reviews with LFRG, regulators, NRC, etc.
- Prepare draft documentation
- Conduct local DOE office reviews
- For DOE 435.1 O PA/CA prepare Revision 0 and submit to LFRG
  - (Subsequent preparation of Revision 1 may be required to respond to LFRG comments)

Review by Applicable Decision Authorities

Implementation of Phased Approach for IDF

2014
Planning Phase
Complete Plan, Complete software QA, Develop Data Packages, Complete Procurement

2015
Scoping Phase
Conduct Workshops, Develop Data Packages, Complete Summary Analysis

2016
Analysis Phase
Complete Data Packages, Complete Model Package Reports, Initiate Process Model Calculations

2017
Analysis Phase
Complete Process Model Calculations, Complete System Model and Calculations, Complete DOE O 435.1 PA document

2018
Review Phase
Conduct Low Level Waste Federal Review Group (LFRG) Review, Develop Risk Budget Tool for Ecology (permit condition)

Implementation of Phased Approach to Define Modeling Approach for 2017 IDF PA

1. Gather relevant historical information
   a) Previous and related analyses and data reports
      i. 1998 and 2001 ILAW Performance Assessments
      ii. 2003 Risk Assessment evaluating supplemental technologies
      iii. Data packages prepared for not completed 2005 IDF PA
      iv. Tank Closure & Waste Management EIS (2012)
      v. Environmental Restoration Disposal Facility PA (2013)
      vi. Waste Management Area C PA (2015)
   b) Previous model and calculation files
      i. Tank Closure & Waste Management EIS calculation files
      ii. ILAW glass dissolution calculation files
      iii. Hydrostratigraphic framework model files
      iv. Central Plateau groundwater flow model files
2. Gather updates and recent related data
   a) Inventory updates
   b) ILAW glass dissolution data for different glasses
   c) Cementitious grout diffusion and adsorption data
   d) Recent interpretations of vadose zone data
3. Conduct scoping calculations using existing model files and recent data
4. Discuss results of scoping calculations and proposed modeling approach at scoping phase workshops
5. Prepare Summary Analysis on modeling approach and provide to DOE/ORP DOE/RL Groundwater Vadose Zone Executive Council and Washington Department of Ecology

Use of *TC&WM EIS* to support IDF PA

- Given the *TC&WM EIS* was used to make a NEPA decision regarding waste management at Hanford, can it be used as a basis for a DOE Order 435.1 Performance Assessment?
- Yes . . . but:
  - Updated scientific information on waste form parameters
  - Site-specific information on vadose zone and saturated zone characteristics and properties
  - Refined information on waste inventory allocation
  - Inclusion of other performance objectives and measures
    - Air pathway dose
    - Radon flux
    - Inadvertent intruder
- Therefore, an important part of defining the approach to be used in the IDF PA was to compare to the *TC&WM EIS*

Summary of Key Assumptions for IDF Model Components for *TC&WM EIS* Model

Model Component	*TC & WM EIS* Model Key Assumptions
Surface barrier	Fixed infiltration rate that changed from 0.5 mm/yr during 500-yr design life to 0.9 mm/yr after design life
Inventory	2002 Best Basis Inventory and inventory allocation resulting in a significant fraction of I-129 on ETF-LSW
ILAW glass	Fixed fractional release rate to vadose zone 2.8E-08 yr^{-1}
Cementitious Waste Forms	Calculate release to vadose zone based on diffusion-controlled release from waste form with effective diffusivity changed after 500-yr design life
Vadose Zone	Calculate release to saturated zone based on ILAW glass and cementitious release to vadose zone using 3-D STOMP model using fixed infiltration rates under IDF
Saturated Zone	Calculate transient flow fields from 3-D site-wide Modflow groundwater model. Calculate transport to specified boundaries using 3-D particle tracking routine.

Comparison of *TC&WM EIS* and 2017 IDF PA - Waste Inventory – I-129 and Tc-99

Waste Form	I-129 (Ci)	Tc-99 (Ci)
ILAW	9.56 (16.5)	28,800 (26,400)
LAW Melters	0.02	37.5
WTP Secondary Solid Waste	4.65 (12.1)	492 (21.2)
ETF-Generated Secondary Solid Waste	33.6 (0.0642)	86.3 (0.229)
FFTF	0	1.48E-02
Secondary Waste	1.43E-05	9.95E-02
On-site, non CERCLA, non tank	1.32E-03	1.21

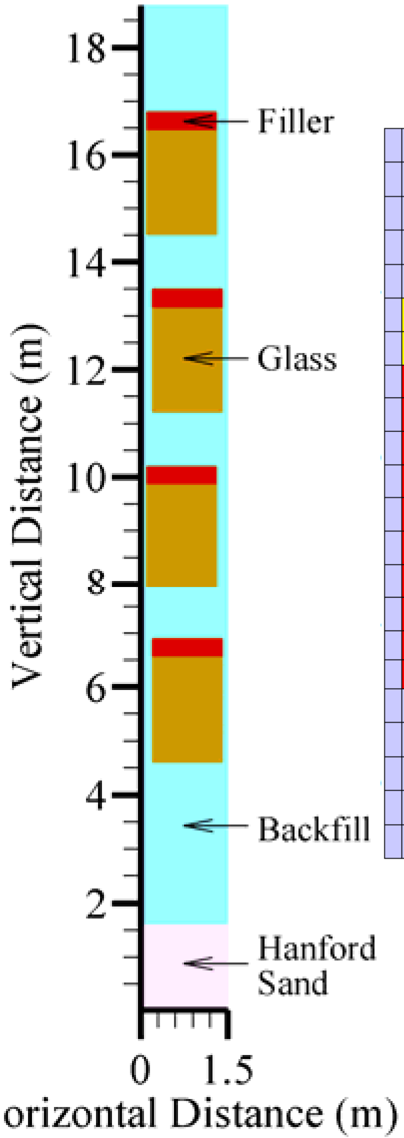
TC&WM EIS Tables D-39, D-80, D-83, and D-84 – Tank Closure Alternative 2B with no Tc-99 removal

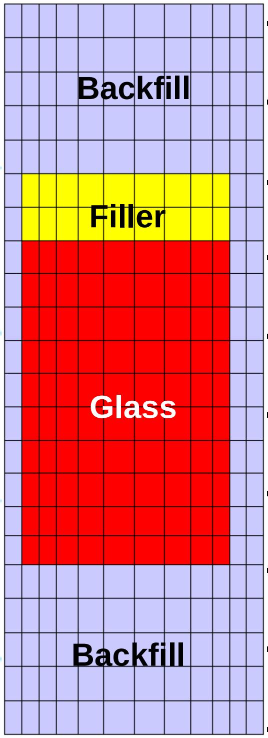
NOTE: ( ) indicate nominal inventory for Case 7 in *Inventory Data Summary for the Integrated Disposal Facility Performance Assessment* (RPP-ENV-58562, Rev 3)

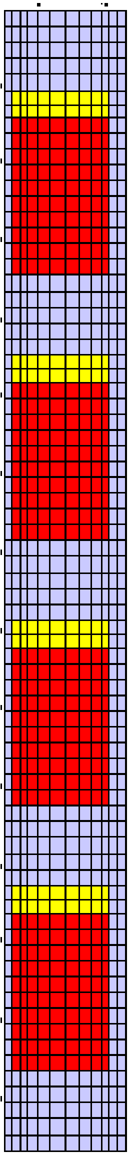
NOTE: TC&WM EIS also analyzed off-site wastes, with assumed I-129 inventory of 2.26 Ci and Tc-99 inventory of 1,460 Ci.

Comparison of *TC&WM EIS* and 2017 IDF PA - ILAW Glass Release Model

- Similarities:
  - Transition-State-Theory (TST) model of glass dissolution
  - Secondary mineral reaction network based on modeling and lab tests
  - Reactive transport software bench marked against one another
- Differences:
  - Lower grid resolution to reduce computational burden (comparisons made)
  - Updated glass compositions and dissolution rate parameter values and ranges
  - Higher net infiltration
  - Augmented with Geochemist's Workbench simulations.





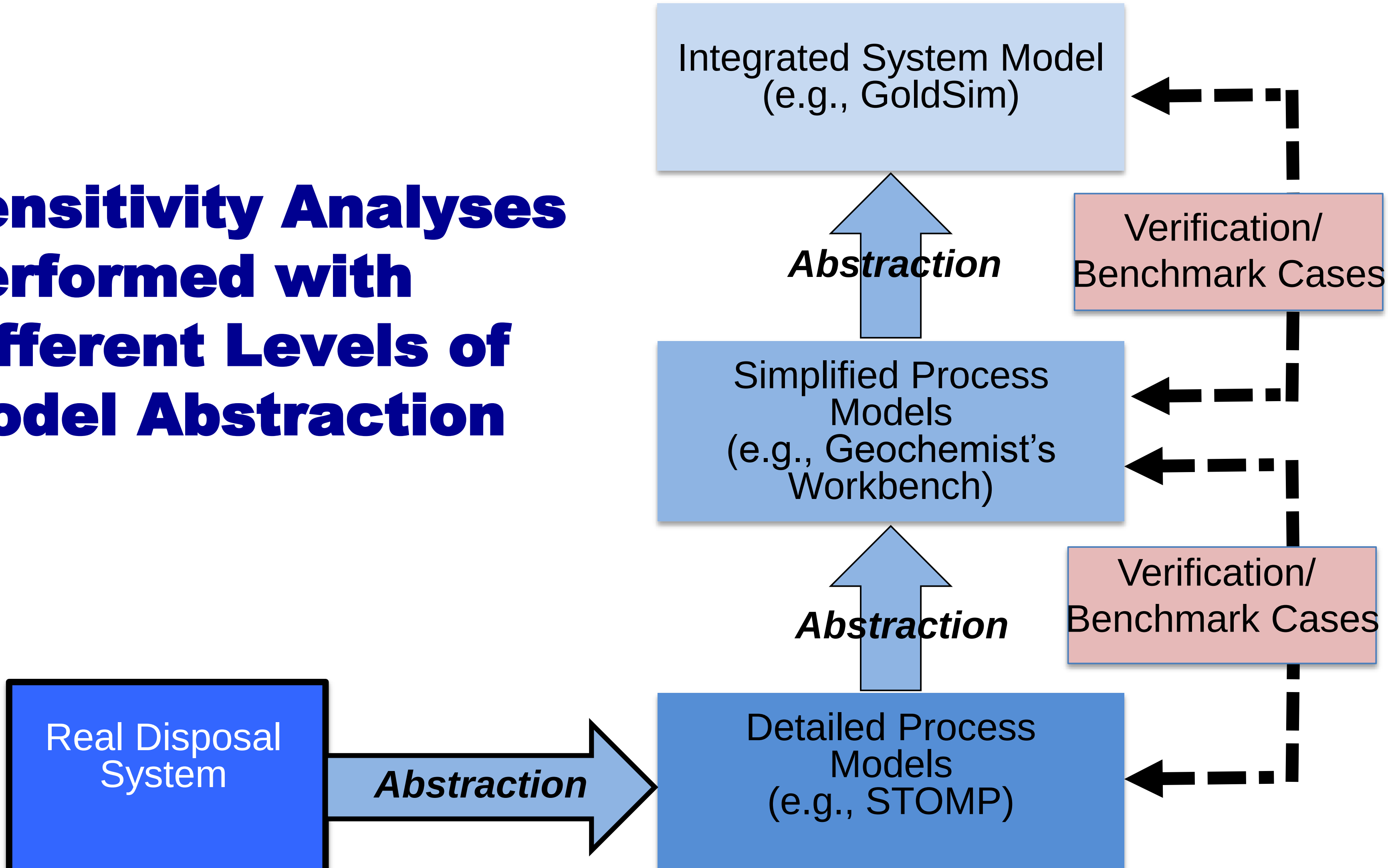


2017 IDF PA Modeling Approach – ILAW Glass Release

- Conduct scoping calculations using alternative release properties
- Use 2-D reactive transport model (STOMP) to derive fractional release rates for congruent dissolution
- Compare results using an alternative calculation model (Geochemist's Workbench)
- Evaluate sensitivity of results using a range of glass dissolution parameter values, alternative glasses and assumed environmental conditions
- Conduct uncertainty analyses over range of glass dissolution parameter values using Geochemist's Workbench and results for use in system model
- Conduct sensitivity and uncertainty analyses using system model

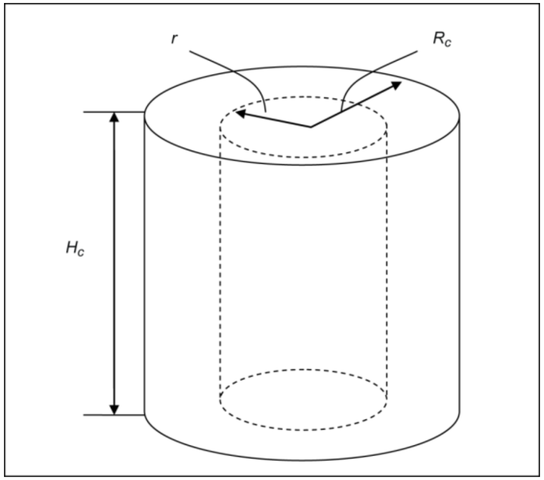
Alternative Models for ILAW Glass Release Calculations

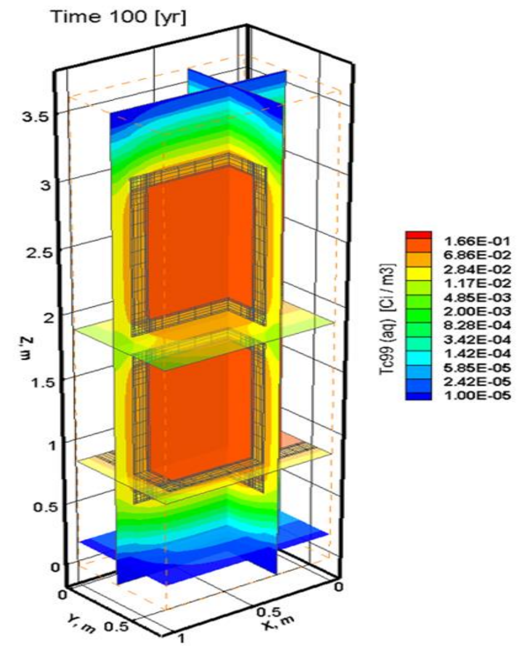
Sensitivity Analyses Performed with Different Levels of Model Abstraction



Comparison of *TC&WM EIS* and 2017 IDF PA - Cementitious Waste Form Release Model

- Similarities:
  - Diffusion dominated release from waste form
  - Cylindrical waste packages
  - Homogenous distribution in solidified waste forms
  - Advection dominant in backfill
- Differences:
  - Analytical vs. 3-D numerical solution
  - Waste stream specific properties and inventory
  - Cement aging
  - Effective diffusivity coefficients and sorption onto cement materials and waste substrate
  - IDF PA includes box geometry
  - IDF PA includes encapsulated debris



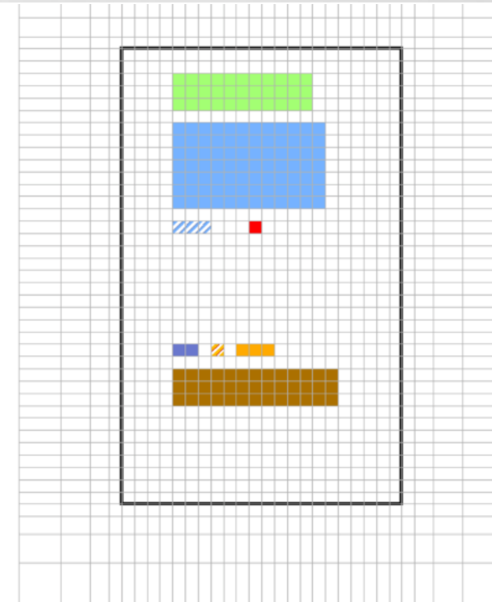


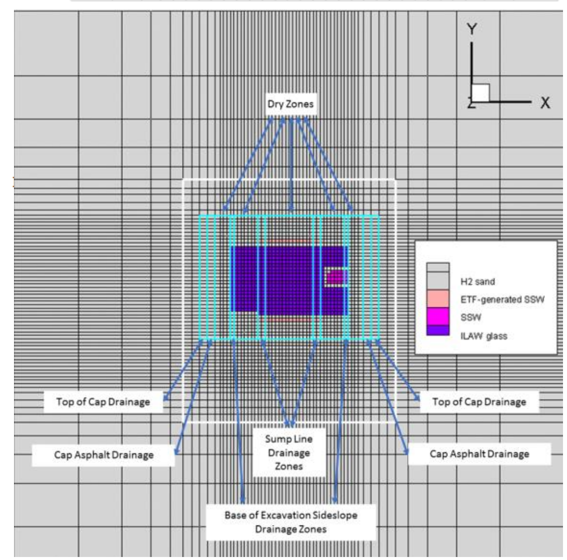
2017 IDF PA Modeling Approach – Cementitious Waste Form Release

- Conduct scoping calculations using alternative release properties
- Develop 3-D advective-diffusive transport models using STOMP
- Develop alternative 3-D STOMP models for different waste containers (drums vs boxes), configurations (solidified vs encapsulated) and secondary solid waste streams
- Update effective diffusivity and K_d values from recent testing and data synthesis
- Conduct sensitivity analyses based on ranges of parameter values and design/operations choices
- Develop simplified diffusive release model in system model
- Conduct sensitivity and uncertainty analyses using system model

Comparison of *TC&WM EIS* and 2017 IDF PA - Vadose Zone Flow and Transport Model

- Similarities:
  - 3-D STOMP model
  - Similar geo-framework model
  - Grid resolution
  - Partially saturated sediments
  - Sorption of key COPCs
- Differences:
  - Source zone footprint
  - Recharge rate beneath facility
  - Flow from IDF can be focused within facility and released beneath sump lines
  - IDF-specific hydrologic properties
  - Potential significance of vertical and horizontal heterogeneity
  - Directly coupled to 3-D STOMP model for saturated zone transport



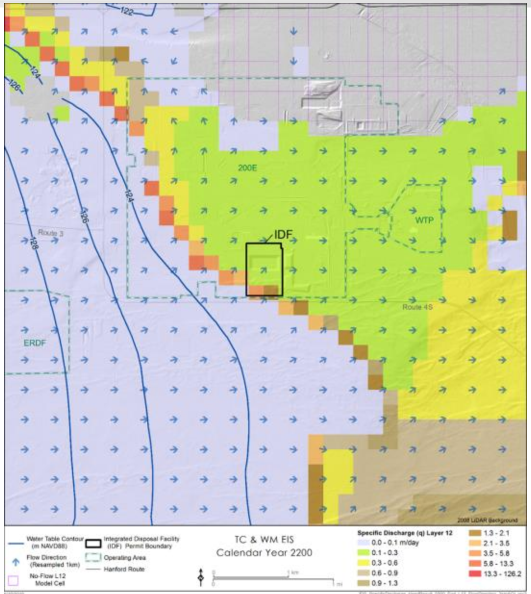


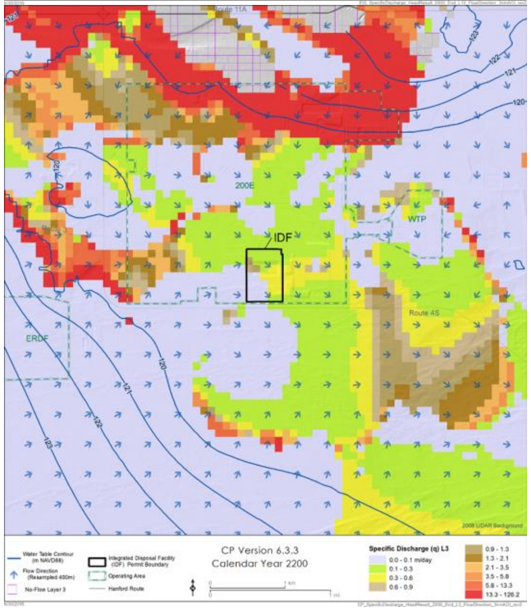
2017 IDF PA Modeling Approach – Vadose Zone Flow and Transport

- Conduct scoping calculations to evaluate impact of alternative assumptions and compare to *TC&WM EIS*
- Develop 3-D vadose zone flow and transport model using STOMP
  - Use IDF-specific hydrostratigraphy including presence of clastic dike
  - Use IDF-specific hydraulic properties based on testing at Sisson and Lu site (400 m east of IDF)
  - Use updated long-term average infiltration rate (3.5 mm/yr)
- Conduct sensitivity analyses over a range of vadose zone property values
- Develop abstraction of 3-D model results for use in 1-D transport in system model
- Conduct sensitivity and uncertainty analyses using system model

Comparison of *TC&WM EIS* and 2017 IDF PA - Saturated Zone Flow and Transport Model

- Similarities:
  - Flow based on regional groundwater models
  - Horizontal dispersivity
  - Groundwater elevation
- Differences:
  - Simulation software (finite difference vs. particle tracking)
  - IDF PA uses an updated flow model
  - Grid resolution
  - Vertical dispersivity
  - IDF-specific hydraulic conductivity estimates
  - Alternative well screen lengths used for ERDF and WMA C PAs
  - Revised point of calculation at 100 m





2017 IDF PA Modeling Approach – Saturated Zone Flow and Transport

- Conduct scoping calculations to evaluate impact of alternative assumptions and compare to *TC&WM EIS*
- Use specific discharge from Central Plateau model
- Extend vadose zone 3-D STOMP model into saturated zone
  - 100-m point of calculation
  - Well screen length of 5 m
  - 10 m x 10 m grid cells consistent with vadose zone model
  - Limit vertical dispersivity to approximate zero vertical dispersivity used in *TC&WM EIS*
- Conduct sensitivity analyses over a range of saturated zone properties
- Develop abstraction of 3-D model results for use in 1-D transport in system model
- Conduct uncertainty analyses using system model

Summary Comparison of Assumptions in *TC&WM EIS* and Updated Information

Topic	Similar Assumptions	Different Assumptions
Facility Design	• 500-yr design life of surface barrier	• Liner system properties
Inventory	• Key constituents of potential concern (COPCs) • FFTF, on-site non-CERCLA non tank, and solid waste inventory	• Updated best-basis inventory • Allocation of inventory between ETF-LSW and SSW waste forms • Allocation of SSW inventory among individual waste streams
ILAW Glass	• ILAW glass release conceptual model	• ILAW glass release properties
ETF-LSW		• ETF-LSW COPC release conceptual model • ETF-LSW COPC release properties
SSW		• SSW COPC release conceptual model • SSW COPC release properties
Vadose Zone	• Hydrostratigraphic units • Recharge/infiltration rate	• Flow and transport conceptual model and properties
Saturated Zone	• Groundwater flow rate	• Groundwater flow model • Contaminant transport model • Hydrostratigraphic units
Exposure Pathways	• Receptor characteristics	• Inclusion of air pathway • Inclusion of radon flux
Inadvertent Intruder	• Receptor characteristics	• Inclusion of chronic and acute inadvertent intruder exposure scenarios

2017 IDF PA Modeling Approach - Summary

- Develop a suite of deterministic process level models using best-estimate input values
  - Near field hydrology
  - ILAW glass release
  - Cementitious waste form release
  - Vadose zone/saturated zone flow and transport
- Evaluate performance relative to performance metrics
- Explore process model sensitivity to parameter and conceptual model uncertainty
- Develop and benchmark system model that integrates abstractions of detailed process level models
- Evaluate sensitivity and uncertainty in integrated system model results to parameter uncertainty.

2017 IDF PA Current Status

- Data packages supporting process models and parameters completed in 2015/2016
- Process model package reports completed in 2016
- Process model calculations completed in 2016/2017
- Integrated system model and calculations completed in 2017
- Performance Assessment document completed in 2017
  - Prepared in accordance with guidance in DOE-STD-5002-2017, *Radioactive Waste Management Disposal Authorization Statement Technical Basis Documentation*
- PA support documents (Monitoring Plan, Maintenance Plan, Closure Plan and Unreviewed Disposal Question Procedure) completed in 2017
- DOE Low Level Waste Disposal Facility Federal Review Group starting review

Key References Supporting the IDF PA

- Key Data Packages
  - Engineered System
  - Natural System
- Key Model Package Reports and Environmental Model Calculation Files

Key Data Packages – Engineered System

Topic	Data Package
Facility Design	RPP-20691, 2015, "*Facility Data for the Hanford Integrated Disposal Facility Performance Assessment*"
	PNNL-23711, 2015, "*Physical, Hydraulic, and Transport Properties of Sediments and Engineered Materials Associated with Hanford Immobilized Low-Activity Waste*"
	DOE/RL-2016-37, 2016, "*Prototype Hanford Barrier 1994 to 2015*"
Inventory	RPP-17152, 2015, "*Hanford Tank* 4 *Waste Operations Simulator (HTWOS) Version 8.1 Model Design Document*", Rev. 12
	RPP-33715, 2015, "*Double-Shell* 1 *and Single-Shell Tank Inventory Input to the Hanford Tank Waste Operations Simulator Model – 2 2015-2 Update*", Rev. 9
	RPP-ENV-58562, 2016, "*Inventory Data Summary for the Integrated Disposal Facility Performance Assessment*," Rev 3
	DOE/RL-0391, 2012, *Tank Closure and Waste Management Environmental Impact Statement*
ILAW Glass	PNNL-24148, 2015, "*ILAW Glass Waste Form Release Data Package for the Integrated Disposal Facility Performance Assessment*"
ETF-LSW	PNNL-25194, 2016, "*Secondary Waste Cementitious Waste Form Data Package for the Integrated Disposal Facility Performance Assessment*"
	SRNL-STI-2015-00685, 2016, "*Liquid Secondary Waste: Waste Form Formulation and Qualification*"
SSW	SRNL-STI-2016-00175, 2016, "*Solid Secondary Waste Data Package Supporting Hanford Integrated Disposal Facility Performance Assessment*"

ILAW = Immobilized Low-Activity Waste glass: ETF-LSW = Effluent Treatment Facility – Liquid Secondary Waste grout
SSW = Secondary Solid Waste grout; PNNL = Pacific Northwest National Laboratory; SRNL = Savannah River National Laboratory; DOE/RL = U.S. Department of Energy/Richland Operations Office

Key Data Packages – Natural System

Topic	Data Package
Vadose Zone	RPP-20621, 2004, "*Far-Field Hydrology Data Package for the Integrated Disposal Facility Performance Assessment*"
	PNNL-13037, 2004, "*Geochemical Data Package for the 2005 Hanford Integrated Disposal Facility Performance Assessment*"
	PNNL-14744, 2004, "*Recharge Data Package for the 2005 Integrated Disposal Facility Performance Assessment*"
	PNNL-14586, 2005, "*Geologic Data Package for 2005 Integrated Disposal Facility Waste Performance Assessment*"
	PNNL-23711, 2015, "*Physical, Hydraulic, and Transport Properties of Sediments and Engineered Materials Associated with Hanford Immobilized Low-Activity Waste*"
Saturated Zone	CP-47631, 2014, "*Model Package Report: Central Plateau Groundwater Model, Version 6.3.3*", Rev. 2
	ECF-HANFORD-13-0029, 2015, "*Development of the Hanford South Geologic Framework Model, Hanford Site Washington, Fiscal Year 2016 Update*", Rev. 4
Exposure Pathways	RPP-ENV-58813, 2016, "*Exposure Scenarios for Risk and Performance Assessments in Tank Farms at the Hanford Site, Washington*"

Model Package Reports and Calculations

Topic	Model Package Report	Environmental Model Calculation File
Facility Design	RPP-RPT-59342, "*Integrated Disposal Facility Model Package Report: Non-Glass Release*"	RPP-CALC-61029, "*Two-Dimensional, Two-Phase Flow Model Calculations for the Integrated Disposal Facility Performance Assessment*"
Inventory	NA – Use results from data package	NA – Use results from data package
ILAW Glass	RPP-RPT-59341, "*Integrated Disposal Facility Model Package Report: ILAW Glass Release*"	RPP-CALC-61031, "*Low-Activity Waste Glass Release Calculations for the Integrated Disposal Facility Performance Assessment*" RPP-CALC-61192, "*Integrated Disposal Facility Performance Assessment: Sensitivity Calculations for ILAW Glass Dissolution Rate Parameters*"
ETF-LSW	RPP-RPT-59342, "*Integrated Disposal Facility Model Package Report: Non-Glass Release*"	RPP-CALC-61030, "*Cementitious Waste Form Release Calculations for the Integrated Disposal Facility Performance Assessment*"
SSW	RPP-RPT-59342, "*Integrated Disposal Facility Model Package Report: Non-Glass Release*"	RPP-CALC-61030, "*Cementitious Waste Form Release Calculations for the Integrated Disposal Facility Performance Assessment*"
Vadose Zone	RPP-RPT-59343, "*Integrated Disposal Facility Model Package Report: Geologic Framework*" RPP-RPT-59344, "*Integrated Disposal Facility Model Package Report: Vadose and Saturated Zone Flow and Transport*"	RPP-CALC-61017, "*Vadose Zone and Saturated Zone Flow and Transport – Sensitivity Analysis Using the Tank Closure and Waste Management EIS Model*" RPP-CALC-61032, "*Vadose Zone and Saturated Zone Flow and Transport Calculations for the Integrated Disposal Facility Performance Assessment*"

Model Package Reports and Calculations

Topic	Model Package Report	Environmental Model Calculation File
Saturated Zone	RPP-RPT-59343, "*Integrated Disposal Facility Model Package Report: Geologic Framework*" RPP-RPT-59344, "*Integrated Disposal Facility Model Package Report: Vadose and Saturated Zone Flow and Transport*"	RPP-CALC-61016, "*Saturated Zone Flow – Sensitivity Analyses Using the 3-D EIS Groundwater Flow Model and the Central Plateau Groundwater Flow Model in the Vicinity of the Integrated Disposal Facility*" RPP-CALC-61032, "*Vadose Zone and Saturated Zone Flow and Transport Calculations for the Integrated Disposal Facility Performance Assessment*" RPP-CALC-61644, "*Supplemental Vadose Zone and Saturated Zone Flow and Transport Calculations with Alternative Waste Loading for the Integrated Disposal Facility Performance Assessment*."
Exposure Pathways		RPP-CALC-61013, "*Groundwater Pathway Dose Calculation for the Integrated Disposal Facility Performance Assessment*" RPP-CALC-61014, Rev. 1, "*Atmospheric Pathway Dose Calculation for the Integrated Disposal Facility Performance Assessment*"
Inadvertent Intruder		RPP-CALC-61015, "*Inadvertent Intruder Dose Calculation for the Integrated Disposal Facility Performance Assessment*" RPP-CALC-61254, "*Inadvertent Intruder Dose Calculation Update for the Integrated Disposal Facility Performance Assessment*"
Integrated System	RPP-RPT-59726, "*Integrated Disposal Facility Model Package Report: System Model*."	RPP-CALC-61194, "*System Model Calculations for the Integrated Disposal Facility Performance Assessment*"